TIGRE RESISTIVITY METER

USER'S MANUAL

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WARRANTY

1. Allied Associates Geophysical Ltd (AAGL) products are fully tested in our workshop both during construction and after completion and are dispatched in full working condition. Instruments are guaranteed for 12 months from the date of dispatch from the factory, liability being limited in accordance with clause 9 of the General Conditions for the Supply of Plant and Machinery for Export (UN Economic Commission for Europe, Geneva, 1953).

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6. AAGL Associates Geophysical Ltd will take all necessary steps to rectify any failure, which is deemed the responsibility of the manufacturer, as quickly as possible.

7. No liability against consequential loss can be accepted under any conditions.

Thank you for purchasing the Tigre Resistivity Meter.

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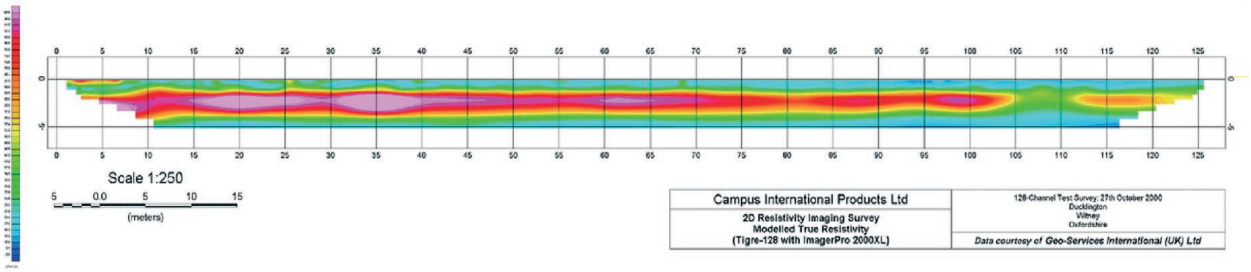

Example of Tigre data.

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INTRODUCTION

THE ALLIED TIGRE RESISTIVITY METER

The Allied TIGRE is a high quality earth resistance meter capable of accurate measurements over a wide range of conditions. To enhance its capabilities it is provided with an RS232 computer link enabling control to be transferred to a PC notebook computer. The TIGRE incorporates banks of relays, which will allow computer-controlled sounding and imaging.

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1 GENERAL DESCRIPTION OF THE SYSTEM

1.1. THE TIGRE

The TIGRE is a high quality earth resistance meter capable of accurate measurement over a wide range of conditions.

It has a maximum power output of 18 watts, manual selection of current in steps up to 200mA, a choice of sample time / signal length averaged and three frequency settings. The receiver incorporates automatic gain steps, which provide a range of measurements from 0.001Ω to 360kΩ.

The instrument is powered by a large capacity rechargeable battery providing several days of use without recharging in average terrain conditions. The TIGRE is housed in an impact-resistant steel case.

1.2. COMPUTER CONTROL

Though the TIGRE can be used as a stand-alone system to carry out electrical profiling or vertical soundings with any type of electrode array, it has been designed with a view to integrating it with a number of resistivity survey systems developed by AAGL. To make this possible, control of the instrument is transferred to a portable notebook computer (IBM compatible). The computer automatically switches in the correct electrodes for each particular measurement through a bank of relays housed in the meter.

Computer control also has the advantage of making possible a much wider range of instrument parameters than would otherwise be practicable. The square wave reversal periodicity and the current-on to current-off ratio can both be modified in order to optimise measurement quality. All data are logged and are immediately available for interpretation. Self-potential readings can also be monitored and there are a number of check routines.

Basic DOS software (TIGIMG and PRM64_2) for operating the computer, can be supplied on request.

1.3. THE SURVEY SYSTEM

The construction of the TIGRE, with its own switching capabilities makes it easy to operate with a variety of survey systems. These can only be operated when the instrument is functioning under computer control.

Offset Wenner Sounding

Electronically controlled switching in the module enables high quality soundings to be measured automatically using the patent OFFSET SOUNDING SYSTEM. Offset Wenner, Schlumberger or Wenner soundings may be easily carried out using the appropriate manual swithching unit and corresponding cables.

Electrical Imaging

The TIGRE can also be used with multicore imaging cables with any electrode spacing Normal operational spacings are either 1m, 2m, 5m or 10m. The software carries out repeated sweeps along with a constant separation 2- 3- or 4- electrode array, increasing the spacing at each sweep, thus producing an electrical cross section (pseudosection) or image of the ground that can be further refined by processing. This is particularly applicable to environmental and engineering site investigations and for archaeological studies. Depending on the amount of switching included in the Tigre, from 1 to 4 cables can be connected directly to the instrument.

1.4. POWER BOOSTER

Starting in July 1999 the power booster is fitted as standard to all Tigre systems providing current capacity to 200mA.

2. THE TIGRE

2.1 CONSTRUCTION

Fig. 1. The Tigre front panel.

The TIGRE is housed in an impact-resistant steel case with removable lid and is fully water-resistant. The various units are mounted below the front panel and the whole instrument can be removed from the case by unscrewing the plate. The transmitter/ receiver controls and display occupy the left hand half of the panel, while client-selected cable sockets are located on the right hand half of the panel.

The design of the TIGRE allows for the construction of a basic resistivity meter or a multi electrode imaging system, up to 128 electrodes. The design concept also allows for straightforward upgrade from 32 electrodes to 128, in modular steps, thus allowing the system to expand in line with customer requirements.

2.2 THE CONTROLS AND CONNECTORS

Fig. 2. TIGRE Lower Left-Hand front panel showing Operation Buttons

All the external controls, together with the liquid crystal display are situated on the top front panel of the instrument. They are fully waterproof. The controls are shown in Fig. 2 and are described below. In addition to the “ON” switch and the “GO” or initiate measurement button, there are three other buttons marked mA, MODE and CYCLES See Fig 3.

ON – OFF

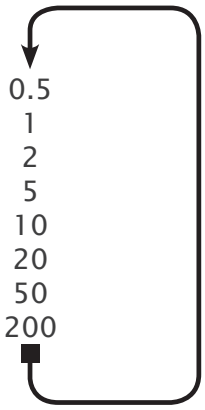
Select to switch the instrument for operation or to switch the instrument off.

GO

Press this button to initiate measuring with the previously set parameters.

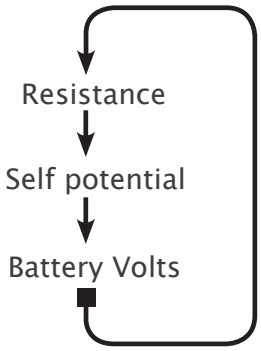
mA (CURRENT)

The button marked mA is used to select the desired current in milli-amps. The current is increased each time the button is pressed in the following steps:



MODE

The button marked MODE selects the type of measurement. The display will indicate the following sequence of options as appropriate.

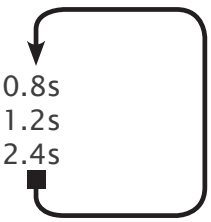


NUMBER OF CYCLES

The button marked CYCLES selects the number of readings to be averaged. This can be from 1 to 16. Details of how the signal is processed to obtain a single measurement of ground resistance are given in Section 2.4. of this manual.

SAMPLE TIME

If the MODE and mA buttons are pressed simultaneously the sample time (or signal length) can be changed as shown below:



APLHA-NUMERIC DISPLAY

The 80-character (4x20) liquid crystal display indicates the parameters selected and the measurement details as the survey progresses. See Fig 3. The display can be backlit by pressing MODE and CYCLES simultaneously. The light automatically switches off after one minute if no activity is sensed during this time.

Fig. 3 TIGRE Display and Electrode Terminals

EXTERNAL POWER SUPPLY

An external 12V power supply may be connected through the socket situated immediately below the RS232 socket. See Fig. 5. A connecting lead is supplied for this purpose. It is important to remember the correct polarity when connecting to an external supply.

WARNING! Do not connect to a car battery while it is being charged!

COMPUTER CONTROL

To operate under computer control, connect any IBM compatible notebook computer to the resistivity meter via the RS232 port. See Fig. 5. A connecting lead is supplied. The correct connections to the instrument are shown below (Fig. 4).

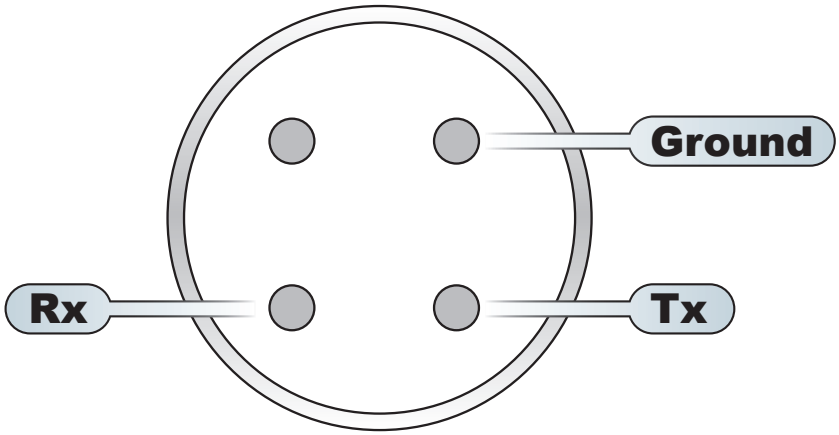


Fig. 4. RS232-port connections

MANUAL CONTROL

The red and black coloured current and potential terminals marked P1, P2, C1, C2, are situated on the front panel – See Fig. 3. Single core cables may be connected to these terminals for measuring earth resistance.

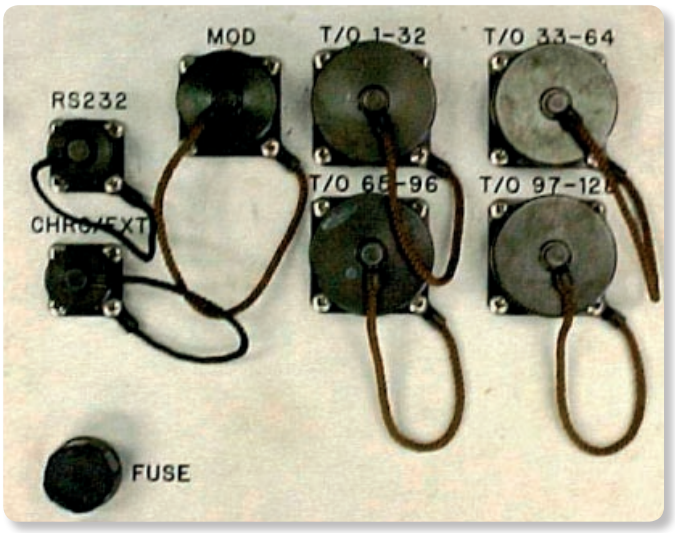


Fig. 5. TIGRE Display and Electrode Terminals

2.3 MAKING MEASUREMENTS

NOTE: the following instructions are for use with DOS programs TIGIMG and PRM64_2 only. For Windows based operation see ImagerPRO section at the end of the manual.

1. Check that the instrument is correctly connected to the current and potential cables. See Fig. 7. When the manual Offset Wenner system is used, the current and potential terminals are connected to the Offset Wenner system switchbox. See separate manual supplied with the Offset Wenner Sounding System.

2. Switch on. Display shows:

```
MODE: Resistance
1=0.5mA  Cycles=2
```

3. Check battery volts. If the battery is below the operating voltage the display will read:

```
BATTERY LOW
Reduce Current
```

4. Take care to keep operating temperature within the specified range. Check the temperature regularly because in tropical sunshine it may well rise above the danger level. Note that although the instrument will operate below 0°C, it is not designed for work under exceptionally low temperature conditions.

5. Check the SP voltage. Use the MODE switch to put the instrument into the Self Potential mode. Make a few measurements to see how it is varying by pressing the GO switch and noting the results obtained. The amplitude and rate of change of the SP will affect the readings at low resistance values and determine the instrument settings required to optimise accuracy.

6. Select the current setting using the mA button. Normally start at 2mA and keep as low as possible, consistent with obtaining good repetition. If ground conditions are such that the instrument cannot deliver the required current or there is an open circuit it will read:

```
CURRENT ERROR
Check Electrodes
```

Decrease the current and/or water the electrodes to improve ground contact. Experience shows that when operating multicore cable systems, accurate measurements are obtained with contact resistances below 2000Ω

7. Select the number of readings to be averaged using the CYCLE button. This will depend to a great extent on ground noise. Start with 4 readings and increase or decrease depending on the consistency of the readings obtained.

8. Select Resistance and press the GO button. The display will initially indicate the voltage gain being used in the measurement.

```
…Setting Gain
G=5  I=2mA  n-3
```

G indicates the amplifier gain setting. These are x5, x0.5, x0.05 and x0.005. In a noisy environment, high and varying SP values may cause the amplifier to saturate during the averaging. The display will show:

```
GAIN ERROR
Change Current
```

In this case, reduce the current to bring the signal within the operating range.

The display will then indicate the successive averages of the resistance, bleeping each time during the process. At the standard setting the instrument takes 2.1s to complete a set of 4 readings. A three-figure resistance will show with the decimal point approximately placed, followed by Ω or mΩ. If the potential and current connections have been incorrectly connected a negative sign will precede the digits. This can also be due to ground conditions.

9. If the switching circuits operated by the current or mode buttons on the top panel are faulty the display will read MODE ERROR.

2.4 THE SIGNAL

The transmitter uses commutated DC to produce the signal shown in Fig. 6 (a).

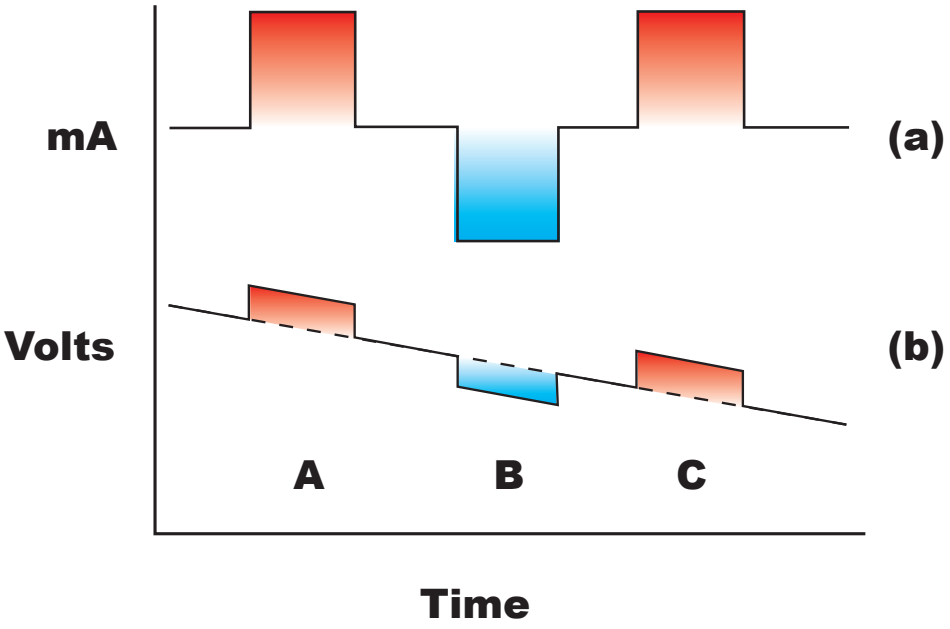


Fig. 6. The TIGRE SIGNAL (a) Transmitted signal (variable Periodicity), (b) Received signal. Here the attenuated and modified signal is superimposed on slowly varying earth currents. It is sampled over times A, B and C.

The on period is sampled for only the last 4/5 of the on time e.g. 0.8s in 1.0s.

An example of the received signal in the presence of electrical ground noise is shown in Fig. 6. b. This figure also illustrates the processing technique used to extract a value of the required potential difference from the received signal, here shown superimposed on a slowly varying earth current. The signal is digitally sampled over times A, B and C and the amplitude calculated as (Va+Vc–2Vb)/4). The on/off ratio is 2.5:1 and the sample/unsampled ratio during any ON period is 4:1. This is to allow any coupling and IP affects to die away before sampling takes place.

When a number of cycles are averaged, the microprocessor calculates the potential difference from successive sets of three “ON” periods, ABC, BCD, CDE, giving values (Va+Vc-2Vb)/4, (Vb+Vd-2Vc)/4, etc.

When conditions are adverse, i.e. a low signal/ground noise ratio, apparent as a lack of consistency in the readings, use higher current settings that do not cause a “GAIN ERROR” and average over 16 cycles. Gain errors are usually due to sudden increases in ground noise saturating the system. If the area is generally very noisy it may be necessary to operate at the longest cycling time. In extreme conditions, i.e. measuring very low resistances against a background of large amplitude and varying SP, highly inconsistent readings may be obtained. In this case it is necessary to put the instrument into the computer command mode and vary the sampling parameters until satisfactory results are obtained. See Section 3.

2.5 POWER SUPPLY

The Tigre uses sealed gel-cell batteries (7 AH at 12V). Under average working conditions (e.g. 10 offset soundings per day at 5mA) recharging every 2 working days would be safe practice. Electrical imaging uses more drain on the batteries and so the instrument should be charged overnight during survey operations.

Should it be necessary to be away from an AC power source for more than a few days the instrument can be operated using an external supply. A 12V-car battery which can be recharged from a vehicle can be used in an emergency. A separate lead is supplied which can be clipped onto the battery. Be sure to check the polarity before connecting to the instrument.

WARNING! Do not run the vehicle engine while the instrument is connected to the battery as transients from the alternator can damage the transmitter circuitry.

2.6 BATTERY CHARGER

This operates from 240V or 115V AC. The maximum current output is such that batteries can be left on indefinitely without suffering and damage. Charging time from full discharge is 16 hours. If storing the Tigre for a long period of time, recharge the battery every month. Failure to do so will result in irreversible damage to the battery neceessating it’s replacement.

NOTE: if the meter is operated while the battery is being charged, the charger is automatically disconnected.

3. ELECTRICAL IMAGING WITH THE TIGRE

3.1 INTRODUCTION

The Allied TIGRE contains a switching module, which enables automatic addressing of multi-electrode survey systems. The minimum configuration allows for the switching of up to 32 electrodes. Additional onboard modules will allow for 64 and 128 electrodes.

Using the DOS based TIGIMG program and PRM64_2, then each survey electrode may be addressed and set up as either one of the current electrodes C1 or C2, or one of the potential electrodes, P1 or P2. An electrode may be addressed to take two roles so that, for example, it can act as both C1 and P1. Additionally far electrodes may also be connected directly to the Tigre resistance meter. The system therefore has complete versatility. If using Windows, please see ImagerPRO section at the back of the manual.

3.2 THE SYSTEM

The IMAGER cables should be connected to the TIGRE at the sockets marked **CABLE 1**, **CABLE 2** etc. A portable Laptop computer is connected to the **RS232** port.

The relationships of the electrodes to the relays in the control module are shown in Fig. 7. The following description assumes that standard 32-takeout cables are employed in the surveys.

A. A single IMAGER cable. If a single IMAGER cable is being used it should be connected to the socket marked **CABLE 1**. In this case relays 1 – 32 will correspond to the electrodes 1 – 32 numbered from the connector (See Fig. 7. A). This is true for 32 and 62 channel systems.

B. Two IMAGER cables. When two cables are connected to the control instrument, the electrodes will normally be numbered from one end of the line of 64 electrodes to the other end. In this case relay 32 will correspond to electrode 1 and relay 1 to electrode 32. On the second cable, relay 33 will correspond to electrode 33 and so on to relay 64 which will correspond to electrode 64. Full details are shown in Fig. 7 B. This is true for 32 and 62 channel systems.

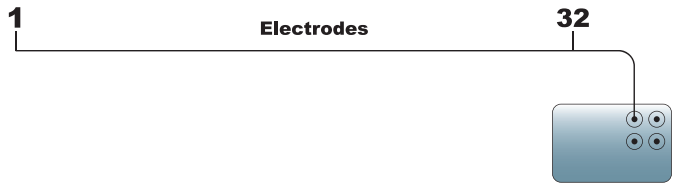
C. Two IMAGER cables with Tigre 128. See Fig. 7 C for cable deployment method using an extension cable.

D. Four IMAGER cables with Tigre 128. See Fig. 7 D

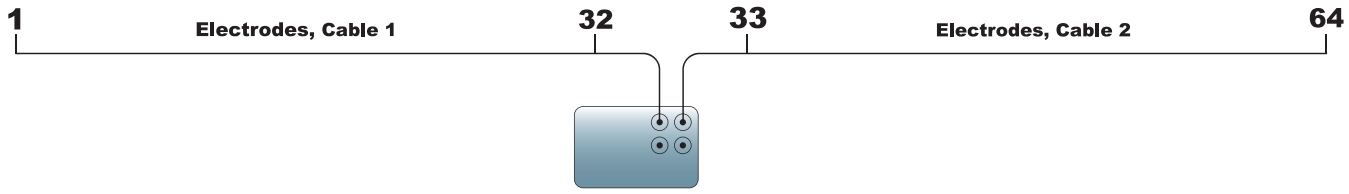
3.3 CHOICE OF CABLE

Select a cable with electrode spacing suitable for the problem being studied. If measurements are made with multiples, n, of the unit electrode spacing, a, from n = 1 to n = 8, the depth range covered is approximately from a/3 to 6a although the greatest response will be from the depth range a/2 to 4a. For example, a 1 meter spacing would be used to study the range 0.5 to 4m.

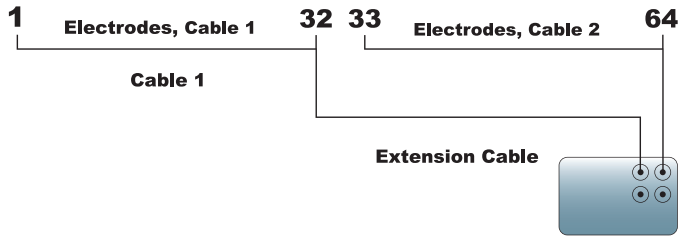
A. SINGLE CABLE WITH TIGRE 32/64



B. TWO CABLES WITH TIGRE 64



C. TWO CABLES WITH TIGRE 128



D. FOUR CABLES WITH TIGRE 128

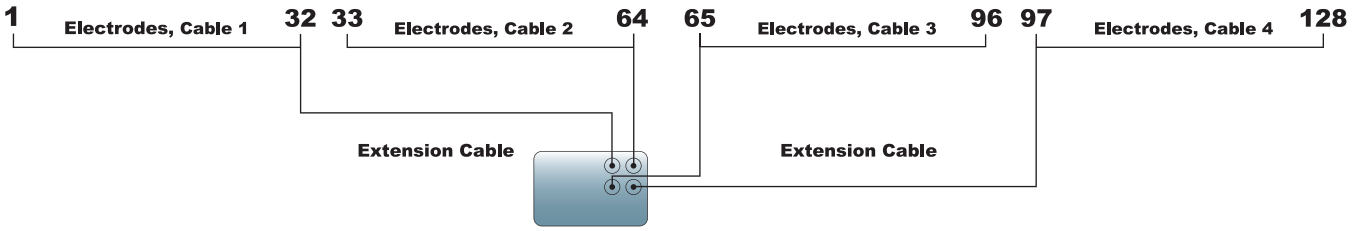


Fig. 7. Electrode connections.

3.4 LAYING OUT THE CABLES AND ELECTRODES

The IMAGER cables are set out in a straight line and electrodes connected to every takeout. The electrodes should be inserted into the ground to a depth of no more than 5% of the unit electrode spacing. For small spacing cables special small electrodes are supplied so that the operator is not tempted to plant electrodes to greater depths. Nevertheless the operator should ensure that good ground contact is achieved. In dry conditions each electrode should be withdrawn and a small amount of water added to the hole before replanting the electrode.

When all the electrodes have been connected, the system is ready to run the program TIGRECON.

3.5 DESIGNING AND CARRYING OUT A SURVEY WITH TIGIMG AND PRM64_2 CONTROL SOFTWARE.

NOTE: the following instructions are for use with DOS programs TIGIMG and PRM64_2 only. For Windows based operation see ImagerPRO section at the end of the manual.

The system may be set up to operate routinely with any particular set of electrodes and cables to carry out specific survey measurements. The survey design is stored in a parameter file, which once created can be accessed by the control software whenever needed. However, the parameter file has to be created when the survey is first run.

A fast method of setting up parameter files for the measurement of Wenner pseudosections is included as a separate program PRM64_2.EXE. The parameter file should be created before running TIGIMG. Parameter files for other types of survey are best created using EXCEL or other software. Once in the field ready to start measurements, the laptop computer is switched on and the system booted. Run TIGIMG and follow the instructions. After the title screen, the correct serial port (COM1 or COM2) must be selected. The following main menu then appears:

```
*************TIGRECON MAIN MENU************

            Please enter option
Load/Create parameter file.................1

View parameter file........................2

Edit parameter file........................3

Take/continue resistance measurement.......4

Show resistance measurements...............5

Save resistance measurements...............6

Repeat a measurement.......................7

Check contact resistance...................8

Exit to system.............................9
```

Select Option 1

OPTION 1

When Option 1 is selected the following menu appears.

```
Enter parameter filename (use no spaces)     -     *.prm
```

Enter the filename of the previously created parameter file. The filename should be no more than 8 characters long. The file extension .PRM is provided by the computer automatically.

OPTION 2

Select this option to view the data in the parameter file. The following type of information will be displayed:

Test Survey

```
Reading    Current    Cycles    Ton       Toff      P1        P2        C1        C2
1          10         2         1.0       0.5       1         2         3         4
2          10         2         1.0       0.5       2         3         4         5
3          10         2         1.0       0.5       3         4         5         6
4          10         2         1.0       0.5       4         5         6         7
5          10         2         1.0       0.5       5         6         7         8
6          10         2         1.0       0.5       6         7         8         9
                                 Press any key to continue
```

OPTION 3

Select this option if further editing is required. Screen messages are as described in Option 1.

OPTION 4

Select this option to start a survey using the parameters described in the parameter file. The following message appears:

```
File filename.PRM allows 6 different measurements

Select option:-

                    All measurements.......1
                    Selected range.........2
                    Continue survey........3
```

If only a selected range is required the program will ask for:

```
Number of first measurement?

Number of last measurement?
```

Sub-option 3 above can be used after a set of resistance measurements has been interrupted (where the user has had to return to the main menu to edit a parameter file for example).

The computer then prints a message instructing the operator to:

```
SWITCH ON METER
SWITCH ON METER
SWITCH ON METER
SWITCH ON METER
SWITCH ON METER
SWITCH ON METER
```

The computer then completes a set of resistance measurements displaying the results as they are obtained.

OPTION 5

The resistances may be examined using this option. If it is necessary to repeat a measurement, the operator should proceed to Option 7.

OPTION 6

Select this option to store data on disk. A filename for data storage has to be supplied.

OPTION 7

To repeat a measurement, the number of the measurement as it appears in the parameter file has to be entered.

OPTION 8

The software provides the possibility of estimating electrode contact resistances. This is done by first measuring resistances at 3 electrodes at which good ground contact is certain. By default, the TIGRE selects the first (closest) three electrodes on Cable 1. Assuming no cable resistance and negligible ground resistance, a set of simultaneous equations is solved to provide contact resistances at the first three electrodes. All other contact resistances are measured in relation to electrode 1. For this reason, it is important that electrode 1 is correctly connected.

Contact resistances will be displayed as they are measured.

High contact resistances are generally not a problem if multicore cables are being used, as the TIGRE has a very high input impedance. However, one effect of high electrode contact resistance when multicore cables are used, is an increase in coupling between cores and consequent distortion of the observed waveform. This can be quite severe in laboratory experiments where the measuring system itself can add to the distortion of the waveform. In field surveys our experience suggests that good data can be recorded if contact resistances are lowered to less than 200Ω. This is done by watering electrodes with saline water, emplacing them in clay or using multiple electrodes.

3.6 INSTRUMENT PARAMETERS

The suggested values below have been selected to produce measurements with the minimum of power. The operator can increase the speed of the survey by reducing the current on time to 1 second or less. If this is done it is likely that the current will have to be increased to 1, 2 or 5 mA, depending on the electrode spacing used. If unstable measurements are obtained, the current should be increased. Currents of more than 100 mA should not normally be employed with IMAGER cables.

Example settings for 1m, 2m and 5m cables might be as follows:

1m cable

Level	Current	Cycles
1	0.5	3
2	1.0	3
3	1.0	3
4	1.0	4
5	1.0	4
6	2.0	4
7	2.0	4

2m cable

Level	Current	Cycles
1	1.0	3
2	2.0	3
3	2.0	4
4	2.0	4
5	2.0	4
6	5.0	4
7	5.0	4

5m cable

Level	Current	Cycles
1	2.0	4
2	5.0	4
3	5.0	4
4	5.0	4
5	5.0	4
6	10.0	4
7	10.0	4

In low resistivity conditions the current should be increased further. Check the waveform to make sure that a good voltage signal is being detected.

In noisy conditions either the current on time or the number of cycles should be increased.

3.7 SURVEY MODES

Traverse

There are two survey modes that can be employed. Traverse mode allows the completion of all measurements with n=1 before commencing with the n=2 measurements and so on. With a 32 electrode cable a complete pseudosection measured in traverse mode will comprise the following number of measurements at each level.

Level	Electrode spacing	Number of measure-ments
1	a	22
2	2a	19
3	3a	16
4	4a	13
5	5a	10
6	6a	7
7	7a	4

Traverse mode measurements are shown in Fig. 8.

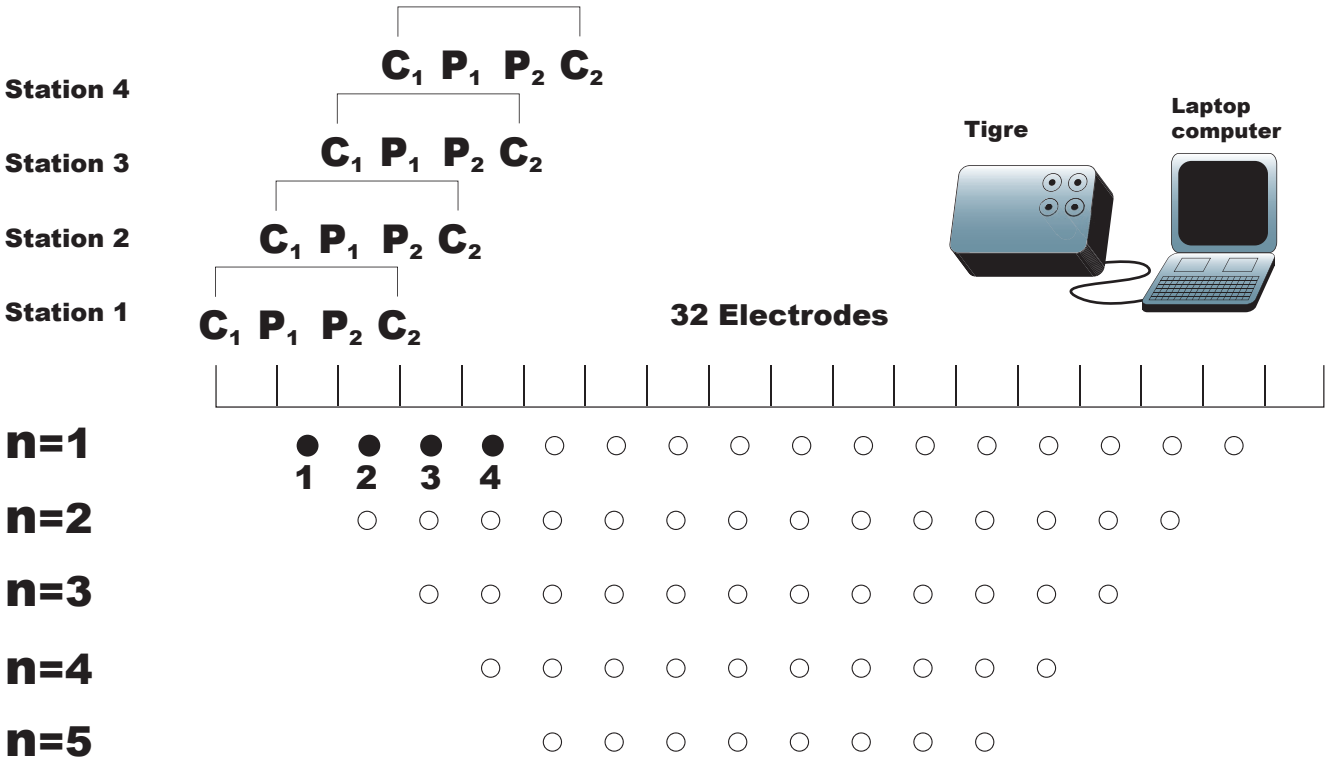


Fig. 8. Principle of electrical imaging with a multicore cable in traverse mode

Roll-on

Roll-on mode takes measurements for n=1, 2, 3, 4, 5 and 6 for station 1 before continuing in the same way for station 2 (Fig. 9). This type of survey should be used if the survey line is likely to extend to more than 32 electrodes. The operator can stipulate the number of measurements which are made before the cable is moved and the process repeated. There are many ways such a survey can be carried out but the following technique will provide continuous cover at Level 7 quickly and efficiently.

1. The cable is set out and measurements are made in Roll-on mode for 7 stations. The table above shows that this is the maximum number of measurements possible at Level 6 with 32 electrodes deployed. Be sure to record the data before progressing .

2. The cable is disconnected and moved along the line until takeout 1 arrives at electrode 8. The 7 used electrodes are moved to the forward end of the line so that 32 electrodes are again connected.

3. The TIGIMG survey program is continued in Roll-on mode for a further 7 stations. The measured data are appended to the end of the data file created in step 1.

4. The process is repeated until the final cable position is reached.

5. At the end of each roll-on stage a message is displayed.

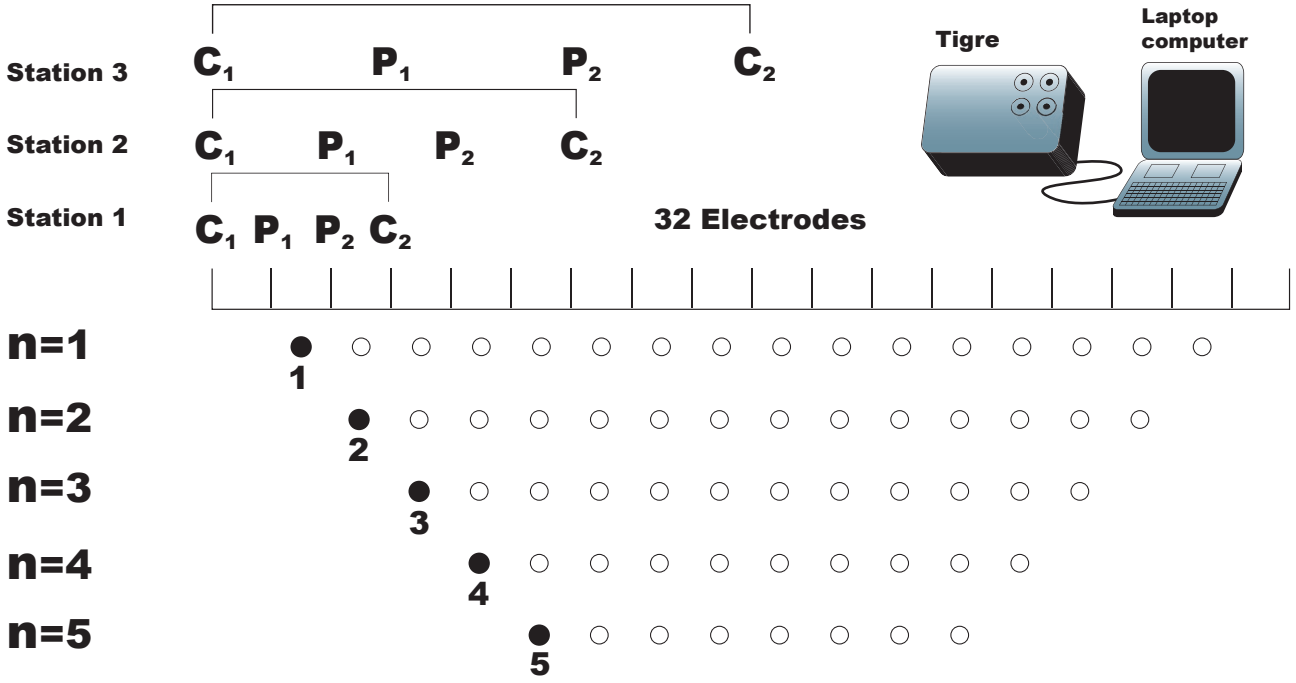


Fig. 9. Principle of electrical imaging in roll-on mode.

3.8 PROBLEMS

This version of TIGIMG control software has been tested under a variety of field conditions but inevitably problems will occur when it is used in different environments. It is hoped that these problems will be minor. If you experience problems or have comments on the use of TIGIMG please contact Allied Associates Geophysical Ltd.

3.9 PRESENTATION OF DATA

The observed data can be plotted as a conventional pseudosection. An approximate depth scale may be provided using the following guide:

when	depth
n = 1	= a / 2
n = 2	= a
n = 3	= 3a / 2
n = 4	= 2a
n = 5	= 5a / 2
n = 6	= 3a

The pseudosection can be contoured and viewed as an approximate image of the subsurface. An automatic inversion program – RES2DINV – is available and enables coloured images of the ground to be produced automatically. Alternatively it can be modelled using a forward modelling program such as RESIXIP2D also available from Allied.

4. TIGRE SPECIFICATIONS

TRANSMITTER

Maximum power output:	18W
Current range :	0.5mA to 200mA
Square wave repetition:	8.4s, 4.2s. 2.8s.
Number of readings averaged:	1 to 16.

RECEIVER

Input voltage range:	0 –180V with auto gain averaging.
Input impedance:	22MΩ
Measurement range:	360KΩ – 0.001Ω
Low pass filter	
Display:	80 character alphanumeric liquid crystal
Power supply:	Rechargeable sealed lead acid. 7 AH @ 12V

GENERAL

Weight:	6kg
Electrode capacity	32 to 128 (optional)

Link to portable IBM compatible PC provides:

1. Wide choice of waveform and frequency
2. Choice of sampling interval
3. Display of received waveform
4. Data logging

5. CERTIFICATE OF CONFORMITY

Product: Charger for TIGRE earth resistance meter

Serial No. .....

Date of Shipment: .....

EMC 89/336/EEC Generic EN50081/1 Light Industrial Emissions,
EN50082/1 Light Industrial Immunity

Tests Applied

BSEN 55011 Class B Conducted Emissions

BSEN 55011 Class B Radiated Emissions

BSEN 61000-4-4 Fast Burst Transients to Level 2 Light Industrial

BSEN 61000-4-2 Static Discharge to Level 2 Light Industrial

Category 1 PASS

Low Voltage Directive 73/23/EEC: N/A below 50V AC.
Machinery Directive 98/37/EEC: N/A – no moving parts.

We, on behalf of Allied Associates Geophysical Ltd, confirm the Product described above meets the requirement in all respects.

Signed…….. Authorised Signatory……..

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England. LU5 5BQ
Tel: ++44 (0) 1582 606 999
Fax: ++44 (0) 1582 606 991
e-mail: info@allied-associates.co.uk

CERTIFICATE OF CONFORMITY

Product: TIGRE earth resistance meter

Serial No. .....

Date of Shipment: .....

EMC 89/336/EEC Generic EN50081/1 Light Industrial Emissions,
EN50082/1 Light Industrial Immunity

Tests Applied

BSEN 55011 Class B Radiated Emissions

BSEN 61000-4-4 Fast Burst Transients to Level 2 Light Industrial

BSEN 61000-4-2 Static Discharge to Level 2 Light Industrial

Category 3 PASS

BSEN 55011 Class B Conducted Emissions: N/A - battery only
Low Voltage Directive 73/23/EEC: N/A below 50V AC.
Machinery Directive 98/37/EEC: N/A - no moving parts.

We, on behalf of Allied Associates Geophysical Ltd, confirm the Product described above meets the requirement in all respects.

Signed..... Authorised Signatory.....

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Alllied Associates Geophysical Ltd

USER MANUAL COMMENTS SHEET

Please note on a copy of this form any suggestions for improvement or any errors found in this manual. Please return the form to:-

Graham White
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Manual Title:

Rev Number:

Comments: